Docket 74508XNAB
Customer No. 01333

#22
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1-28-01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of

David Kessler, et al

ANTI-ALIASING LOW-PASS BLUR FILTER FOR REDUCING ARTIFACTS IN IMAGING APPARATUS

Serial No. US 08/770,381

Filed 25 October 1999

Group Art Unit: 2712

Examiner: J. Wilson

I hereby certify that this correspondence is being deposited today with the United States Postal Service as first class mail in an envelope addressed to Commissioner for Patents, Before the Board of Patent Appeals and Interferences, Washington, D.C. 20231.

Tara M. Piccone

Tara M. Piccone

1-17-01

Date

Commissioner for Patents
Box AF
Washington, D.C. 20231

Sir:

APPEAL BRIEF PURSUANT TO 37 C.F.R. 1.192

1/29/01
DG

01/29/2001 WLAWSON 00000001 050225 08770381
01 FC:120 310.00 CH

Attorney for Appellants
Nelson A. Blish
Registration No. 29,134

EASTMAN KODAK COMPANY
Patent Legal Staff
343 State Street
Rochester, New York 14650-2201

Telephone: (716) 588-2720
Facsimile: (716) 477-4646

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APPELLANT'S BRIEF ON APPEAL

Appellants hereby appeal to the Board of Patent Appeals and Interferences from the Examiner's Final Rejection of claims 1, 4, 5, 10-12, 15, 17, and 18 which were contained in the Office Action mailed September 12, 2000.

A timely Notice of Appeal was filed November 17, 2000.

Real Party In Interest

As indicated above in the caption of the Brief, the Eastman Kodak Company is the real party in interest.

Related Appeals And Interferences

No appeals or interferences are known which will directly affect or be directly affected by or have bearing on the Board's decision in the pending appeal.

Status Of The Claims

Claims 1, 4, 5, 10-13, 15, and 17-19 are pending in the application.

Claims 2, 3, 6-9, 14, and 16 have been canceled.

Claims 1, 4, 5, 10-12, 15, 17, are 18 are rejected under 35 U.S.C. 103.

Claim 13 is objected to and Claim 19 incorporates the limitation of claims 12 and 13.

Claims 1, 4, 5, 10-12, 15, 17, and 18 are being appealed.

Appendix I provides a clean, double spaced copy of the claims on appeal.

Status Of Amendments

A Response Under 37 CFR 1.116 and a Notice of Appeal were filed on November 17, 2000. An Advisory Action dated December 18, 2000 was received notifying Applicant that the Amendment After Final was considered but not allowing the claims. The Advisory Action stated the amendments would be entered upon filing a Notice of Appeal and Appeal Brief. Appendix I, Claims on Appeal, reflect this amendment. Other than this Brief, no response has been filed since the Advisory Action.

Summary Of The Invention

The present invention provides a physically thin blur filter that is inexpensive and relatively simple to manufacture, yet which produces a tightly controlled blur pattern.

According to a feature of the present invention an imaging apparatus for generating an image signal from an incident image limits higher spatial frequencies of the incident light to reduce undersampling artifacts. The apparatus includes an image sensor for generating the image signal from an array of photosites, and an optical section having a highly birefringent uniaxial crystal optical filter, such as lithium niobate, interposed in the path of the incident image light to produce a blurred image on the photosites.

According to another feature of the invention a four spot filter is made by using two plates made of highly birefringent crystal such as lithium niobate as double refractors with a quarter wave retarder between them. The three pieces are cemented together. The first double refractor separates the beam into two linearly polarized beams with separation in the vertical direction. The retarder converts the two linearly polarized beams into circularly polarized beams which are then split in the horizontal direction by the second double refractor. For a spot separation of 9 μm, a filter made according to the present invention is only 0.46 mm thick compared with the 3.04 mm thickness of the prior art filter using crystal quartz. Lithium niobate has a large birefringent and can easily be ground and polished for this purpose.

Another aspect of the current invention is a rhomboidal four spot blur filter which uses a total of only two plates with their optical axis at 45 ° to each other. The filter is rotated about the camera axis to efficiently reduce aliasing artifacts. Reducing the number of components in the filter reduces the cost of the filter and the cost of cementing since only one cementing operation is needed per filter instead of two.

Issues For Review By The Board

The following issues are presented for review by the Board of Patent Appeals and Interferences:

1. Are claims 1, 10, 11, 12, and 15 unpatentable under 35 U.S.C. 103(a) over Greivenkamp, Jr. (U.S. 4,575,193) in view of Fukushima (U.S. 5,579,420)?

2. Is claim 4 unpatentable under 35 U.S.C. 103(a) over Greivenkamp, Jr. (U.S. 4,575,193) and Fukushima et al. (U.S. 5,646,399)?

3. Is claim 5 unpatentable under 35 U.S.C. 103(a) over Greivenkamp, Jr. (U.S. 4,575,193) and Fukushima (U.S. 5,579,420) as applied to claim 1, and further in view of Takatori et al. (U.S. 5,715,085)?

4. Is claim 17 unpatentable under 35 U.S.C. 103(a) over Greivenkamp, Jr. (U.S. 4,575,193) and Fukushima (U.S. 5,646,399), and further in view of Watanabe et al. (U.S. 3,784,734)?

5. Are a series of requests for quotations incorporating drawings later filed in the patent application, along with supporting correspondence, sufficient to show a date of invention prior to Fukushima (U.S. 5,579,420)?

6. If Fukushima (U.S. 5,579,420) is an improper reference based on Applicant's date of invention, does Greivenkamp, Jr. (U.S. 4,575,193) show all the elements of independent claims 1, 4, and 12?

Grouping Of Claims

In regards to patentability, unless otherwise indicated, the claims within each group do not stand or fall together. Reasons supporting the Applicant's position that the claims in each group are separately patentable are provided in "Arguments" in accordance with Rule 1.192.

The claims are grouped as follows:

Group A: Claims 1, 10, 11, 12, and 15. The patentability of claims 1, 10, 11, 12, and 15 under 35 U.S.C. 103 do not stand or fall together. The patentability of claims 10, 11, and 15 stand or fall with claim 1. The patentability of claim 12 stands or falls alone.

Group B: The patentability of claim 4 under 35 U.S.C. 103 stands or falls alone.

Group C: The patentability of claim 5 under 35 U.S.C. 103 stands or falls alone.

Group D: The patentability of claim 17 under 35 U.S.C. 103 stands or falls alone.

Arguments

The Rejection

1. Claims 1, 10, 11, 12, and 15 are not unpatentable over U.S. Patent No. 4,575,193 (*Greivenkamp, Jr.*) and U.S. Patent No. 5,579,420 (*Fukushima* '420).

Greivenkamp, Jr.

As best understood by Applicant, the Examiner's position is that:

> Greivenkamp, Jr. '193 teaches that an imaging apparatus for generating an image signal from incident light with higher spatial frequencies of

> the incident light limited to reduce undersampling artifacts comprising an image sensor for generating the image signal from an array of photosites, and an optical section having a birefringent uniaxial crystal spatial filter, having a first and second plane plate 16 and 20, interposed in a path of the incident light to produce a blurred image on the photosites (col. 1, lines 40-55; col. 3, lines 50-65). Greivenkamp, Jr. '193 further discloses that by blurring the version of the original image, the spatial resolution is (limited) reduced (col. 1, lines 45-48; also col. 3, lines 61 - col. 4, line 5). This teaches that a portion of the high spatial frequency is removed to produce the blurred image on the photosites. However, Greivenkamp, Jr. '193 fails to disclose the birefringent uniaxial crystal optical filter birefringence is greater than 0.05 and being made of lithium niobate. (Office Action dated September 12, 2000, page 4, lines 1-11).

The prior art cited by the Examiner differs from the present invention in both structure, function, and result. *Greivenkamp, Jr.* teaches that an optical spatial frequency filter may be constructed using a pair of birefringent elements with a wave plate sandwiched between the birefringent elements. The wave plate changes the polarization state of light between the two birefringent elements. The purpose for changing the polarization state is to change the polarization state of a first color by a first amount and the polarization of a second color by a second amount so that the spatial frequency response is substantially color dependent.

In the present invention, the birefringent uniaxial crystal spatial filter does not remove wavelengths, rather it blurs certain high frequencies of the image projected on the filter. In a complex photographic image certain features, for example, a picket fence, may produce high frequencies in a digital image. If the image is sampled at a lower frequency aliasing is produced in the resulting sampled image. In the present invention, a spatial filter blurs the higher frequencies in the image, thereby preventing aliasing in the final image. The total light power remains essentially unchanged by the filter and the blurring is achieved by redistribution of the light.

Fukushima '420

As best understood by Applicant, the Examiner's position is that:

> *Fukushima* '420 teaches an optical filter formed of birefringent crystal such as lithium niobate (col. 5, lines 1-5). Lithium niobate has a birefringent value of 0.09, which is greater than 0.05. The strong

> wavelength dependent characteristics of the polarization conversion resulting from the birefringent characteristic of lithium niobate makes the device useful in applications such as multiplexing and/or demultiplexing. Therefore, it would have been obvious to one of ordinary skill in the art to have the birefringent crystal optical filter to be made of lithium niobate, which has a birefringent greater than 0.05. (Office Action dated September 12, 2000, page 4, lines 12-18).

The *Fukushima* '420 filter removes all wavelengths except for a narrow band. This type of filter is known as a spectral filter, and is a type typically found in a multiplexing apparatus. In an apparatus of this type, portions of the beam with an undesirable wavelength are removed. Thus, the total light power is reduced by the spectral filter.

The structural differences between *Fukushima* and the present invention are significant. Birefringent elements 11 and 13 in *Fukushima* are wedge shaped rather than "a first plane plate and at least a second plane plate" as in the present invention. See claim 1. The *Fukushima* '420 invention also specifies an additional element 12 sandwiched between the two wedge shaped plates, which is a heated birefringent element 18 for changing wave length characteristics. This structure functions differently from the structure claimed in the present invention and would not serve "to reduce undersampling artifacts" in an imaging apparatus such as a digital camera as in the present invention. See claims 1 and 12.

Thus, it is seen that neither of the individual references *Greivenkamp, Jr.* et al. or *Fukushima* '420, nor any combination thereof, contain all the limitations of the present invention. Even if the combination of *Greivenkamp, Jr.* and *Fukushima* '420 included all the limitations of the present invention, and they do not, there is no logic for combining them. Both references are for optical filters, however, *Greivenkamp, Jr.* is for a spatial frequency filter and *Fukushima* '420 is for a spectral filter. The optical design criteria for the two references are different and picking and choosing one part from each and combining them would not be an obvious matter of choice.

The patentability of claim 12 does not stand or fall with the patentability of claim 1 and dependent claims thereof. Claim 1 is directed to an apparatus with "a first plate and at least a second plate of lithium niobate." Claim 12, an

independent claim, has no such limitation on the number of plates. Claim 12 is for an optical filter made of "a highly birefringent uniaxial crystal selected from a group comprised of lithium niobate, lithium tantalate, and calcite." Thus, the independent claim 12 has a birefringent crystal selected from different material than claim 1 and also does not incorporate the limitation for a single plate.

2. Claim 4 is not unpatentable over *Greivenkamp, Jr.* '193 and *Fukushima et al.* (U.S. 5,646,399).

Fukushima et al. '399

As best understood by the Applicant, the Examiner's position is that:

> Fukushima et al. '399 teaches that lithium Tantalate may be used as an optical birefringent crystal element (col. 8, lines 11-15) replacing the lithium niobate. Like lithium niobate, Fukushima et al. '399 teaches that lithium tantalate may also be used to improve the mass productivity. Therefore, it would have been obvious to one of ordinary skill in the art to use lithium Tantalate as a birefringent uniaxial crystal spatial filter. (Office Action dated September 12, 2000, page 6, lines 3-7).

The *Fukushima* '399 reference is for a tunable filter module. This filter module, which splits a first beam and a second beam, varies the center wavelength in the passband according to the center wavelength of the input light.

Once again this is significantly different from the spatial filter in the present invention. The fact that *Fukushima* '399 mentions lithium niobate and lithium tantalate as possible materials to use in a tunable filter modulator does not make it readily obvious to use these materials in a spatial filter. A variety of materials is used in different applications throughout the optical industry; which includes microscopes, telescopes, tunable filters, spectral filters, and spatial filters. The fact that a particular material is used in one optical application does not mean that an inventor would randomly select that material for another application merely because it is used in the optical industry. In addition, the birefringent elements in *Fukushima* '399 are crystal wedge plates 74 and 76, which have been distinguished from the present invention above.

3. Claim 5 is not unpatentable over *Greivenkamp, Jr.* '193 and *Fukushima* '420 as applied to claim 1, above, and further in view of *Takatori et al.* (U.S. 5,715,085).

Takatori et al.

As best understood by Applicant, the Examiner's position is that:

> Neither Greivenkamp, Jr. '193 nor Fukushima '420 teaches an angle between an optical axis of the spatial filter and a line normal to a filter facet is 37.85°. However, Takatori et al. '085 teaches that the angle of the spatial filter with respect to the incident plane is set smaller than an angle of 45° (col. 1, lines 65-68). Takatori et al. '085 teaches that due to the fact that an angle of inclination of the optical axis of the spatial filter with respect to the incident plane is set about 35°, which includes the angle 37.85°, even when the angle of incidence of the incident light is great, variations of the separation width between an ordinary ray and an extraordinary ray are not great, that is, the characteristic of the spatial filter does not vary according to the angles of incidence of the incident light (col. 2, lines 1-9). When an angle of incidence light ray into the incident plane is large, the separation width of the ray varies greatly (col. 1, lines 40-49). It would be advantageous to have the angle set below 45° and about 35° to prevent the generation of a false signal due to the width of the ray. Therefore, it would have been obvious to one of ordinary skill in the art wherein an angle between an optical axis of the spatial filter and a line normal to a filter facets is below 45° and about 35°, which includes the angle 37.85°. (Office Action dated September 12, 2000, page 6, line 11 - page 7, line 6).

Takatori claims a uniaxial filter between he ccd and lens wherein the optical axis of the crystal is at an angle of less than 45 degrees from the optical axis of the system. The reason that Takatori suggests that is to improve the performance of the filter large field of views without compromising the quality of the filtering.

The present invention claims an 37.85 degrees because this is a the usual cut angle for Lithium Niobate used in the mass market, i.e. for TV channel selection, and thus one can reduce the cost of the filter and easily cut the crystal at this specific angle. It is true that 37.85 is less than 45 as per Taketori however it is

a specific case dependent on the use of Lithium Niobate with a totally different advantage.

Claim 5 depends from an independent claim clearly distinguishable from the prior art. Since claim 5 adds additional limitations to a patentable independent claim, it is believed that claim 5 is patentable also.

4. Claim 17 is not unpatentable over *Greivenkamp, Jr.* '193 and *Fukushima* '399, and further in view of *Watanabe et al.* (U.S. 3,784,734).

Watanabe et al.

As best understood by Applicant, the Examiner's position is that:

> Neither Greivenkamp, Jr. '193 nor Fukushima '399 teaches a thickness of the first plate is equal to a thickness of the second plate. However, Watanabe et al. '734 discloses that the sheets (Fig. 20, elements 34a and 34b) are identical to each other (col. 10, lines 67-68). Watanabe et al. '734 teaches the thickness of the sheets (elements 34a and 34b) and creates a rhomboidal pattern of the four spot to be of 45° (col. 11, lines 54-62; see Fig. 22). By creating the thickness of the first plate to equal to a thickness of the second plate having the rhomboidal pattern of the rays, aids in producing color video signals which do not cause any moiré in the reproduced picture. Therefore, it would have been obvious to one of ordinary skill in the art to have the thickness of the first and the second plate to be of equal value. (Office Action dated September 12, 2000, page 7, lines 9-18).

The *Watanabe et al.* reference cited by the Examiner is different from the present invention as further defined in dependent claim 17 in that the rhomboidal pattern is not "rotated about an optical axis of the imaging apparatus."

Fukushima et al.

5. The Declaration of Prior Invention is sufficient to overcome the cited patent Fukushima (U.S. 5,579,420).

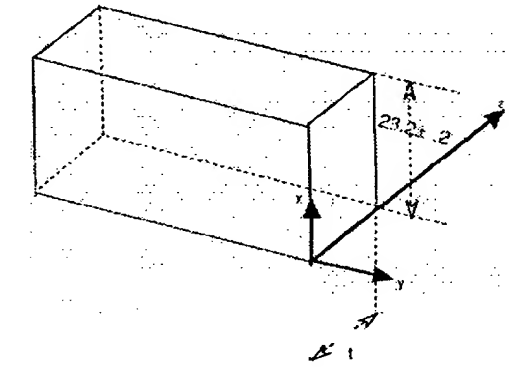
As best understood by Applicant the Examiner's position is that

> The evidence submitted is insufficient to establish a conception of the invention prior to the effective date of the Fukushima references. While conception is the mental part of the inventive act, it must be capable of proof, as be demonstrative evidence or by a complete disclosure to another. Conception is more than a vague idea of how to solve a problem. The requisite means themselves and their interaction

must also be comprehended. See *Mergenthaler v. Scudder*, 1897 C.D. 742, 81 O.G. 1417 (D.C. Cir. 1897). With reference to MPEP 715.02, the declaration must establish possession the whole invention claimed. Furthermore, the declaration under 37 CFR 1.131 is required to show more than what the reference shows. The applicant's declaration must disclose evidence of possession of the invention and not just of what one reference (in combination of applied references) happens to show. (Office Action dated September 12, 2000, page 2, lines 3-12).

It is believed that the demonstrative evidence submitted on July 3, 2000 clearly shows the invention was conceived and in the possession of the inventor prior to the date of both Fukushima references. In particular, it is important to note the relationship of the documents that were submitted supporting the declaration.

Referring to a request for quotation dated August 22, 1995, the document shows Element A and Element B. Element A is the same as the apparatus shown in Fig. 4 of the patent application. See in particular, part number 43.



Element A

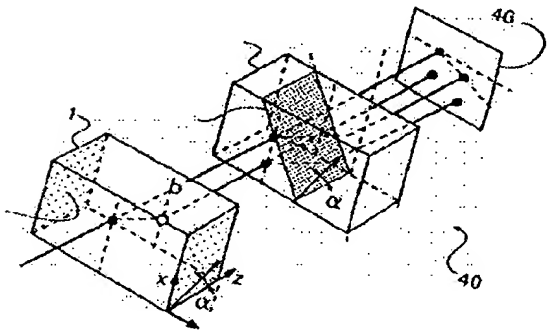
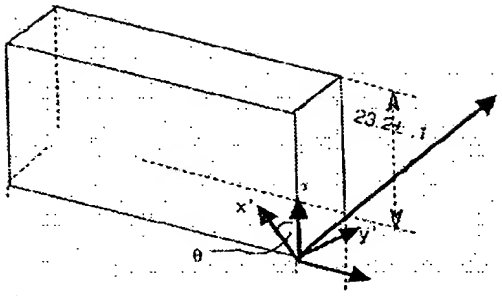


Figure 4 of the present invention



Element B

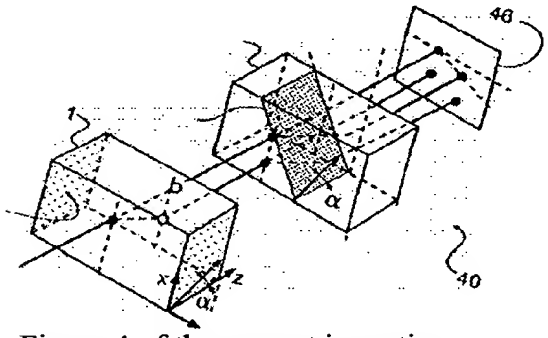


Figure 4 of the present invention

The quotation also shows Element B, which corresponds to Fig.4 of the patent application as filed. In this case refer to part number 42. See the elements exerted below from the patent application and the request for quotation. Thus it is seen that the request for quotation clearly shows the lithium niobate filters described in the specification and shown in the drawings on August 22, 1995.

The August 22, 1995 fax of a request for quotation is shown to have been received and acted upon by the shipping/packing list from Virgo Optics received on September 29, 1995. In the shipping/pack list items A and items B refer back to the original order for Elements A and B, which in turn are shown in the drawings of the patent application as filed as described above. Thus, it is shown that Applicant had possessed the whole invention for a blur filter by at least by August of 1995 and was diligently working on finding a manufacturer to provide the elements of the blur filter.

Other documents, for example, the Deltronic letter dated August 9, 1995, show that lithium niobate was being considered for the blur filter. This reference

discusses the fact that thin plates deform and other problems related to manufacturing this type of thin sliced lithium niobate crystal.

The additional supporting documents shows due diligence and reduction to practice, both by completion of a prototype and by filing of the patent application. Thus it is seen that the inventor was in possession of the complete invention, the requisite means, and their interaction. Therefore, the present invention predates *Fukushima* '420, and that the *Fukushima* be withdrawn reference.

6. The *Fukushima* references do not precede Applicant's date of invention and *Greivenkamp, Jr.* (U.S. 4,575,193) does not show all of the elements of the independent claims.

If the Board agrees that the declaration does in fact show a date of invention prior to either of the *Fukushima* references then the *Greivenkamp, Jr.* (U.S. 4,575,193) does not show all the elements found in the independent claims of the present invention. This is in fact supported by the Examiner's comments in the Office Action mailed September 12, 2000. See for example, page 4, first paragraph, wherein the Examiner states that "*Greivenkamp, Jr.* '193 fails to disclose the birefringent uniaxial crystal optical filter birefringence is greater than 0.05 and being made of lithium niobate." See also page 6, first sentence, wherein the Examiner states that "*Greivenkamp, Jr.* '193 fails to disclose the birefringent uniaxial crystal spatial filter is lithium tantalate." See also page 6, last paragraph, wherein the Examiner states "neither Greivenkamp, Jr. '193 nor *Fukushima* '420 teach an angle between an optical axis of the spatial filter and align normal to a filter facet is 37.85 degrees." See also page 7, third paragraph wherein the Examiner states that "neither *Greivenkamp, Jr.* '193 nor *Fukushima* '399 teaches a thickness of the first plate is equal to the thickness of the second plate."

Thus, in view of the arguments presented above to distinguish the present invention from *Greivenkamp, Jr.* '193 and the Examiner's own statements in the Office Action that *Greivenkamp, Jr.* lacks many of the elements in the present invention it is maintained that the present application is patentable over *Greivenkamp, Jr.*

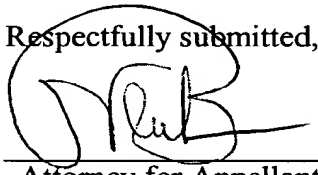
Summary

In summary, it is noted that the Examiner has stated that claim 13 contains allowable subject matter if rewritten in independent form including all the limitations of the base claim and intervening claims. This has been done in the form of claim 19, which has been entered by the Examiner on the filing of this brief. It is also believed that the amendment entered by the Examiner corrects the informalities noted under 35 U.S.C. 112, since the Examiner made no statement to the contrary in the Advisory Action filed the Examiner.

Conclusion

For the above reasons, Appellants respectfully request that the Board of Patent Appeals and Interferences reverse the rejection by the Examiner and mandate the allowance of Claims .

Respectfully submitted,



Nelson A. Blish/tmp
Telephone: (716) 588-2720
Facsimile: (716) 477-4646
Enclosures

Attorney for Appellants
Registration No. 29,134

Appendix I - Claims on Appeal

CLAIMS BEING APPEALED

1. An imaging apparatus for generating an image signal from incident light with higher spatial frequencies of said incident light limited to reduce undersampling artifacts, said apparatus comprising:

an image sensor for generating the image signal from an array of photosites;

an optical section having a birefringent uniaxial crystal spatial filter interposed in a path of the incident light which removes a portion of said high spatial frequencies in said incident light to produce a blurred image on said photosites, said birefringent uniaxial crystal optical filter birefringence being greater than 0.05, and said birefringent uniaxial crystal optical filter being lithium niobate; and

wherein said spatial filter is comprised of a first plane plate and at least a second plane plate of lithium niobate.

4. An imaging apparatus for generating an image signal from incident light with higher spatial frequencies of said incident light limited to reduce undersampling artifacts, said apparatus comprising:

an image sensor for generating the image signal from an array of photosites;

an optical section having a birefringent uniaxial crystal spatial filter interposed in a path of the incident light which removes a portion of said high spatial frequencies in said incident light to produce a blurred image on said photosites, said birefringent uniaxial crystal spatial filter being Lithium Tantalate; and

wherein said spatial filter is comprised of a first plane plate and at least a second plane plate of lithium tantalate.

5. An imaging apparatus as in Claim 1 wherein an angle between an optical axis of said spatial filters and a line normal to a filter facet is 37.85°.

10. An imaging apparatus as in Claim 1 wherein said blurred image is comprised of at least four spots.

11. An imaging apparatus as claimed in Claim 1 wherein said optical section includes a lens, and said optical filter is positioned between said lens and said photosites for blurring the image on said photosites.

12. An imaging apparatus for generating an image signal from incident light with higher spatial frequencies of said incident light limited to reduce undersampling artifacts, said apparatus comprising:

an image sensor for generating the image signal from an array of photosites; and

an optical section having an optical filter made of a highly birefringent uniaxial crystal selected from a group comprised of lithium niobate, Lithium Tantalate, and calcite interposed in the path of the incident image light so as to produce at least four spots at a detector plane.

13. An imaging apparatus as set forth in Claim 12 wherein said birefringent uniaxial crystal optical filter is comprised of two double refractors, and said four spots form a rhomboidal pattern wherein a sharp angle of the rhomboid is 45° and wherein the spatial filter is rotated about an optical axis of the imaging apparatus such that a base of the rhomboidal pattern forms an angle with one of two major coordinates of the imaging apparatus of between 20° to 40°.

15. An imagining apparatus as in claim 1 wherein said second plate comprises a plane which is tilted at a 45° angle to a plane of said first plate.

17. An imaging apparatus as in claim 1 wherein a thickness of said first plate is equal to a thickness of said second plate.

18. An imaging apparatus as in claim 1 wherein a thickness of said first plate is not equal to a thickness of said second plate.

19. An imaging apparatus for generating an image signal from incident light with higher spatial frequencies of said incident light limited to reduce undersampling artifacts, said apparatus comprising:

an image sensor for generating the image signal from an array of photosites;

an optical section having a spatial filter made of a highly birefringent uniaxial crystal selected from a group comprised of lithium niobate and lithium tantalate interposed in the path of the incident image light so as to produce at least four spots at a detector plane; and

wherein said birefringent uniaxial crystal spatial filter is comprised of two double refractors, and said four spots form a rhomboidal pattern wherein a sharp angle of the rhomboid is 45° and wherein the spatial filter is rotated about an optical axis of the imaging apparatus such that a base of the rhomboidal pattern forms an angle with one of two major coordinates of the imaging apparatus of between 20° to 40°.